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STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY

Task 9.0

A Study of the Effects of Varying the
Established Operating and Maintenance
Procedures of the EASL Facility
15 August 1967

JPL CONTRACT 951624 - PHASE II

THIS WORK WAS PERFORMED FOR THE JET PROPULSION LABORATORY, CALIFORNIA INSTITUTE OF TECHNOLOGY, SPONSORED BY THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION UNDER CONTRACT NAS7-100.

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-NOTE-

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CHANGES

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Task 9

A Study of the Effects of Varying the Established Operating and Maintenance Procedures of the EASL Facility

I. Introduction

Task 9 was conducted to determine what effect on the accumulation of Microbiological burden on hardware assembled in EASL might result from variations in the standard environmental conditions in that facility. Standard EASL conditions are a temperature range from $70^{\circ}F \pm 10^{\circ}F$, relative humidity of 45% ± 5% with an air flow velocity of 75 ft/minute ± 20 ft/minute.[1] During normal operations the temperature ranges from 69° - $78^{\circ}F$ and the humidity from 43% - 47%.

Three mechanical assemblies (timer devices as shown in Fig. 1) were constructed under each of the following variations.

1. High temperature (83°) and standard humidity (45%).
2. High temperature (83°) and low humidity (20%-25%).
3. Standard temperature/humidity with air blowers off.
4. Standard EASL environment -- controls.

Disassembly of the timers was carried out immediately following their assembly and twenty groups of individual parts per timer were assayed for the accumulated burden of viable particles.

During all constructions the environmental conditions in the EASL Facility were monitored by means of Reyniers air samplers, stainless steel fallout strips, and Rodac impression plates, in accord with

NASA Procedures[2]. Certification procedures[1] prior to study showed that the EASL Facility met environmental requirements.

II. Materials and Methods.

The mechanical assemblies, along with the necessary tools for their construction were decontaminated in an ETO chamber. Prior to being passed into the EASL assembly room, the plastic bags containing these items were thoroughly wiped down with 70% isopropanol. The individual timer parts are listed and identified in Appendix A. The assembly procedure is detailed in Appendix B; the disassembly for bio assay in Appendix C; and the groups of parts for bioassay are listed in Appendix D. Both assembly and disassembly were performed by personnel clad in sterile gowns, hoods, rubber gloves, and masks. The timers were assembled in the laminar downflow assembly area of the EASL Facility. Disassembly was done at a horizontal laminar flow work bench.

All environmental monitoring procedures and bio assay methods were conducted according to NASA Procedures[2]. During the assembly procedure in EASL the intramural environment was monitored. Reyniers air samplers were located to the right, left, and rear of the assembler as shown in Figure 2. They were run for one-half hour before, during the entire assembly period, and for one-half hour after completion of each assembly. Trays of stainless steel strips were exposed on the worker's right and left sides (Fig. 2.). Six strips were removed for assay immediately following exposure of the strips, and at the beginning, mid-point, and end of the four hour assembly period. The first six strips served as sterility controls. Two Rodac impression plates were taken on both sides of the worktable at the same samplings times as for the strips. See Figure 2 for Rodac plate sites.

Both assembly and disassembly procedures were monitored and logged by Quality Assurance personnel.

The Microbiological assay procedure for timer parts was as follows:

1. On disassembly of the timers the individual assay groups were placed in sterile glass jars to which was added 1% peptone water.
2. These containers were exposed to ultrasonic radiation (25kc) for 12 minutes.
3. Aliquots of the peptone water were pipetted aseptically into each of four sterile plastic Petri dishes, and sterile Trypticase Soy Agar was added.
4. The remainder of the Peptone water was heated at 80°C for 20 minutes and plated as in step 3.
5. Two plates from each set of four were incubated aerobically at 32°C and two anaerobically at 32°C for 72 hours. Plate counts were done at 24, 48, and 72 hours, for aerobes, and at 72 hours for anaerobes.

III. Results

The results of the bio assays are summarized in Tables I through 4. Table 1 lists the counts from Reyniers Plates, as viable particles per cubic foot of intramural air. There was an increase in the number of particles collected during the assemblies done in the absence of laminar downflow. An increase in count was apparent during the period of high temperature and high humidity. (See discussion). The counts under normal EASL conditions and under low humidity-high temperature conditions were similar. Fewer viable particles were collected when the humidity was decreased, but not to a significant degree. (See discussion).

The Rodac plates were essentially negative for growth during the entire study, except when the blowers were off. See Table 2.

Table 3 records the counts obtained from the stainless steel fallout strips. A contamination problem arose during this study which was traced to the sonicator transducer tank. This affected those items sonicated lying horizontally in the tank, which included all the fallout strips and timer part 14. Due to severe assembly time constraints, it was not possible to stop the assembly sequence in order to correct this situation. Immediate steps were taken to preclude the recurrence of this situation but with only partial success. (See recommendations).

The counts from the groups of timer parts are in Table 4. There was no notable difference in the microbial burden on these parts during any assembly except for assay group 9 from Timer 12, and assay group 11 from Timer 11. The high counts on part 14 are the result of contamination from the sonicator tank as previously noted.

There was no growth on the plates incubated anaerobically.

IV. Discussion

The data accumulated in Task 9 indicate that lack of air flow increased the microbial burden of the environment in the EASL assembly facility during a work period of approximately four hours. This is most clearly shown by the increase in the number of viable particles collected by the Reyniers air samplers under the previously mentioned variations in comparison to the normal environment of EASL. A base line accumulation of surface and intramural air microbial burden was maintained due to the cleaning action of the air flow which was restored to specified velocity between assemblies. No significance can be attributed to the burden on the fallout strips exposed during this study because of the possibility of contamination introduced in the sonication process. These counts were the result of contamination, as was shown by the recovery of the same organism from cultures of the transducer tank, the transfer medium, and the sonicated peptone water. Cultures of the heatshocked peptone water were consistently negative for bacterial growth. The bacterial population was found to be contained in a reservoir leading to the drain of the transducer tank. To eliminate this problem a 0.1% solution of Hyamine 3500 (a quaternary ammonium compound) (Rohm and Haas) was used to rinse the tank and allowed to remain in the reservoir overnight following each day's work. Since this was not entirely successful, it was decided to use 1" x 2" x 02" strips in place of the 1" x 3" x 02" strips in subsequent monitoring procedures. The smaller strips may be sonicated with the containers in an upright position. This is in accord with NASA Standard Procedures for assay of fallout strips[2].

Study of the Quality Assurance log for each day's work revealed correlation between personnel QA violations (e.g. exposure of skin and hair) and microbial burden increases during the assemblies. It was noted that on two occasions there was difficulty in disassembling the timers. This may be the cause of the high counts seen on part 4 of Timer 5, part 11 of Timer 10, and part 9 of Timer 12. It is also possible that the latter two assay groups may have accumulated burden in the building process because of personnel QA violations. Torn gloves or lack of coverage of gown sleeves by gloves were the commonest violations.

The trend towards a decrease in the number of viable particles collected from the intramural air under the low humidity condition was not statistically significant. The apparent increase in burden at high humidity and high temperature in the intramural air was also not statistically significant. A statistical analysis of these data is contained in Appendix E.

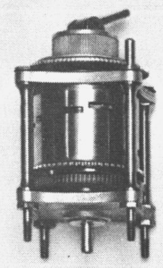
V. Conclusions

1. Microbial burden was increased during assemblies in which EASL Laminar Air Flow was stopped.
2. The other variations from normal EASL environmental conditions did not significantly increase the microbial burden.
3. Violations of the clothing requirements by personnel may result in increased burden on piece parts.

VI. Recommendations

1. A more detailed study of the effects of humidity variations on the accumulation of Microbiological burden in EASL would be desirable.
2. Stronger gloves of the gauntlet type of design be used to prevent contamination by exposure of wrists, arms and hands of personnel.
3. Replace 1" x 3" x .02" stainless steel fallout strips with 1" x 2" x .02" strips to prevent contamination during sonication. This size is in accord with NASA Standards[2] and is now being used in present Microbiological efforts.

VII FIGURES AND TABLES



PT. # 300 TIMER

PT. # 300 TIMER ASSY

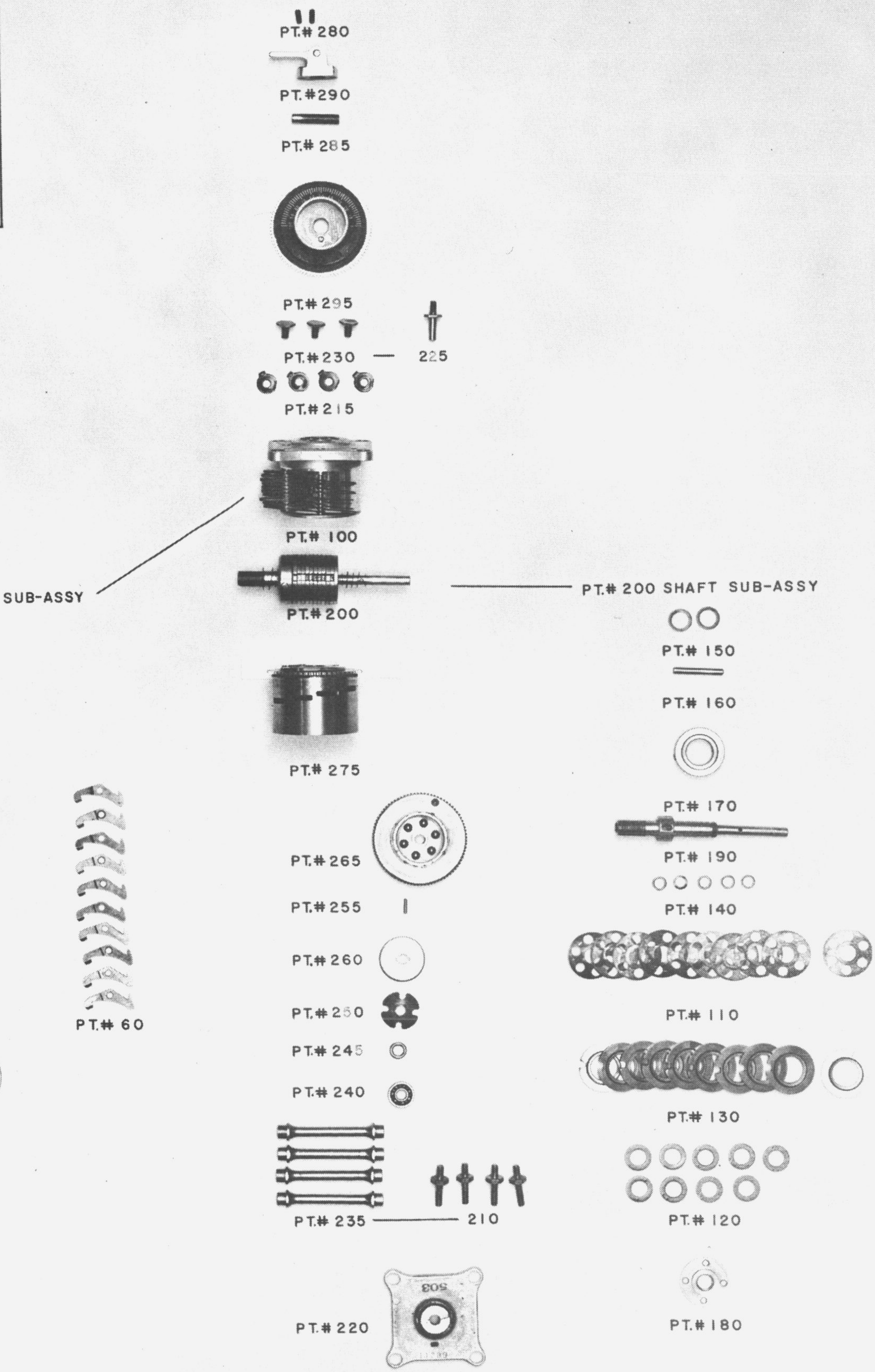


FIGURE 1

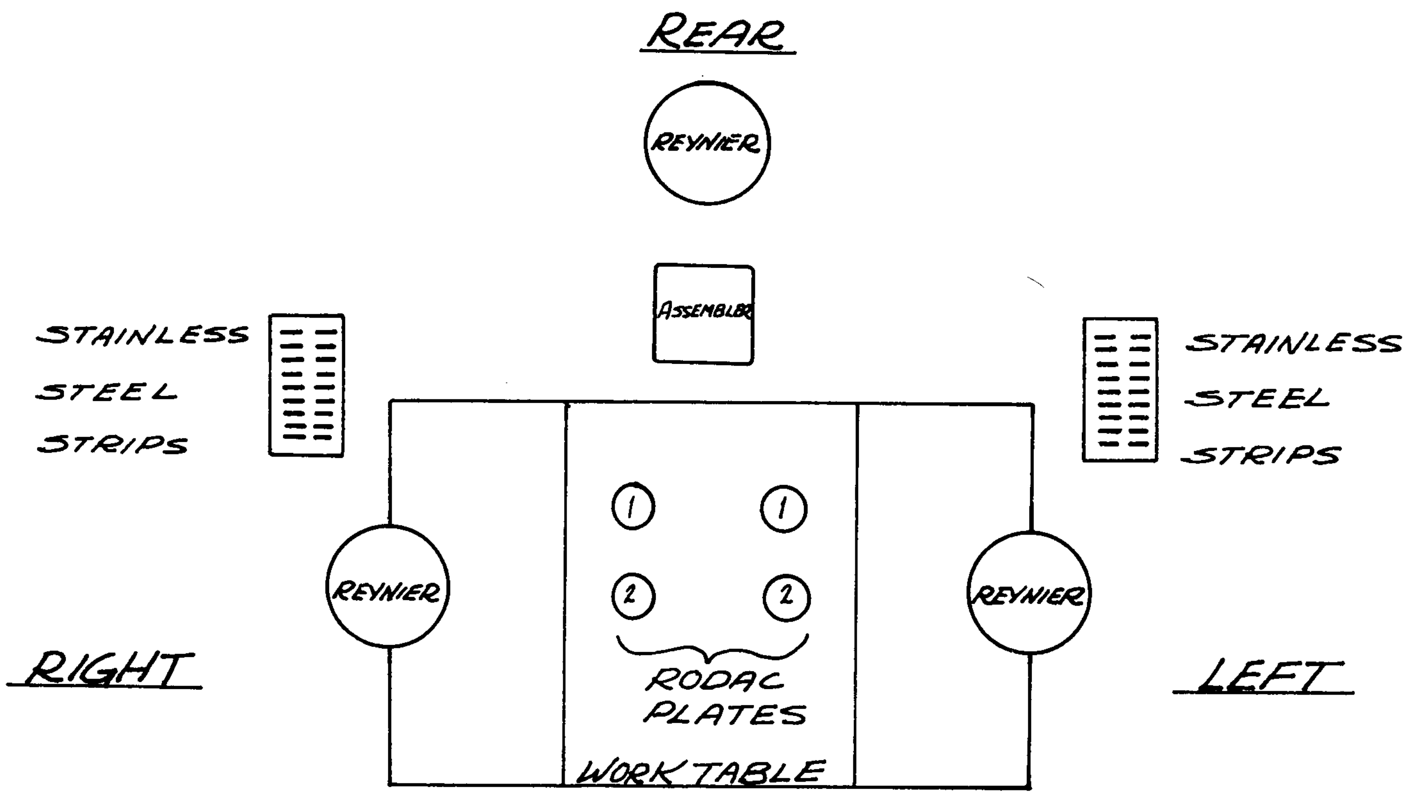


FIG. 2 SAMPLING SITES FOR REYNIER AIR SAMPLER RODAC PLATES, STAINLESS STEEL FALLOUT STRIPS DURING TASK 9

Table 1

REYNIER PLATE - COUNTS

Task 9 Reynier Counts -

		EASL: Normal Spec.			EASL: $83^{o}F$: 20-25% RH			EASL: $83^{o}F$; 45% RH			EASL: Blowers Off		
		Timer			Timer			Timer			Timer		
		1	2	3	4	5	6	7	8	9	10	11	12
Site and Time		Viable Particles/ft^3 Air											
Left	1/2 hr. before	0	.3	0	0	0	0	.3	-	.3	3.8	1.6	3.6
	1st hr.	0	0	0	0	.15	0	.15	0	0	2.5	3.1	2.0
	2nd hr.	0	0	0	0	0	0	0	0	0	1.8	2.1	1.7
	3rd hr.	1	0	0	0	0	0	0	0	0	3.1	2.3	2.4
	1/2 hr. after		0	0			0	0	0	0	2.3	2.2	1.2
								0					
Right	1/2 hr. before	0	.3	0	0	0	0	0	0	0	2.3	1.8	2.4
	1st hr.	0	0	0	0	0	0	0	.3	.15	2.4	2.7	1.7
	2nd hr.	1	0	0	0	0	0	0	0	0	2.6	2.6	1.5
	3rd hr.	0	.15	0	0	1	0	0	.3	0	3.3	2.4	2.2
	1/2 hr. after		0	0			0	0	.3	0	3.1	1.1	1.6
								.3					
Rear	1/2 hr. before	0	0	0	0	0	0	0	0	0	3.1	1.8	5.6
	1st hr.	0	0	0	0	0	0	0	0	0	2.7	4.0	2.9
	2nd hr.	0	0	0	0	0	0	0	0	.15	2.2	3.0	1.8
	3rd hr.	0	0	0	0	0	0	.15	1	0	4.4	2.6	2.2
	1/2 hr. after		0	0			0	.15	.3	.15	2.3	1.8	1.4

Table 2

Surface Burden on Worktable Colonies*/Rodac Plate

Sampling Hour	Rodac Site**	Environment Normal EASL			RH $83^{o}F$ - 20-25%			$83^{o}F$ - 45% RH			Blowers Off		
		Timer 1	2	3	4	5	6	7	8	9	10	11	12
1	Left 1	0	0	0	1	0	0	0	0	0	0	1	0
	2	0	0	0	0	1	0	0	0	0	0	45	0
	Right 1	0	0	0	0	0	0	0	0	0	0	1	0
	2	0	0	0	0	0	0	0	0	0	0	2	0
2	Left 1	0	1	0	0	0	0	0	0	0	0	1	0
	2	1	0	0	0	0	1	0	0	0	0	0	1
	Right 1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	2	0	0	0	0	0	0	0	0
3	Left 1	0	0	0	0	0	0	0	0	0	2	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	11
	Right 1	0	1	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	1	0	0	0	0	0	0	1	0 0

Table 3

Stainless Steel Fallout Strips - Viable Particles*/ft.^{2} Surface

	EASL NORMAL SPECS.							
	Controls		First Hour		Second Hour		Third Hour	
Timer	Left**	Right**	Left**	Right**	Left**	Right**	Left**	Right**
1	0	0	0	$9.6 \times 10'$	0	3.7×10^4	1.7×10^4	$9.6 \times 10'$
2	0	$9.6 \times 10'$	0	$9.6 \times 10'$	$9.6 \times 10'$	$4.8 \times 10'$	0	$4.8 \times 10'$
3	1.9×10^4	1.4×10^5	9.6×10^4	7.7×10^4	4.8×10^2	3.8×10^4	7.2×10^5	2.9×10^4
	EASL: 83°F. 20 - 25%RH							
4	0	0	$9.6 \times 10'$	0	7.2×10^5	7.2×10^5	1.9×10^4	3.2×10^5
5	0	2.4×10^3	1.4×10^4	9.6×10^3	0	0	1.4×10^2	0
6	0	0	7.2×10^3	1.3×10^5	0	9.6×10^3	2.7×10^4	3.4×10^2
	EASL: 83°F 45% RH							
7	0	$9.6 \times 10'$	5.8×10^3	2.4×10^5	9.6×10^2	2.9×10^3	7.7×10^3	2.9×10^3
8	0	0	3.4×10^3	0	1.9×10^3	0	4.8×10^3	7.2×10^3
9	0	0	9.6×10^2	3.0×10^4	4.8×10^3	0	1.4×10^3	0
	EASL: BLOWERS OFF							
10	0	0	1.4×10^2	1.4×10^2	2.4×10^2	2.9×10^2	4.3×10^4	$2.4 \times 10'$
11	1.4×10^2	$3.4 \times 10'$	0	0	2.9×10^2	1.4×10^2	2.6×10^3	2.9×10^2
12	1.4×10^2	$9.6 \times 10'$	1.4×10^2	0	4.3×10^5	9.6×10^5	1.9×10^5	4.8×10^4

NOTE: It is highly unlikely (given the contamination possibilities when sonicating strips in Bussey bottles lying down) that counts over 10^2 are true counts or true indications of the microbial fallout under the conditions of these procedures in EASL. This premise is supported by the data from the Reynier samples and the Rodac samples and the randomness of the counts. A possible exception would be during the building of Timers 10-12 when the laminar down-flow was turned off.

* - Aerobic Mesophiles **See Figure 2.
Average of six strips/assay.

Table 4

Timer Assay Groups   Viable Particles*/Group

	NORMAL EASL COND.			83°F - 20-25% RH			83°F - 45% RH			Blowers Off		
	Timer 1	2	3	4	5	6	7	8	9	10	11	12
Assay Group												
1	0	0	0	5	0	5	0	10	5	0	0	0
2	0	10	0	5	5(5)	0	0	0	0	0	0	0
3	0	0	5	0	0	0	0	5	0	10	0	0
4	0	0	0	0	435**	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	25(25)	0	20	5(5)	0	0	0	0	0	0	0
7	0	0	0	20	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	110
10	0	0	0	0	0	0	0	0	0	0	0	0
11	20	0	0	0	0	50(50)	0	0	0	205†	0	25
12	0	0	10	0	0	40(40)	0	0	0	0	0	75
13	0	0	0	0	0	Lab accident	0	0	0	0	0	0
14	0	0	465**	15	0	5(5)	0	4470**	0	5	0	0
15	0	0	5	5	0	0	0	0	0	0	0	0
16	5	0	0	0	0	0	0	0	0	0	5	0
17	5	0	0	0	0	0	0	0	0	15	0	0
18	0	0	0	5	0	0	0	0	0	10	0	0
19	0	0	0	0	10	0	0	0	0	0	0	0
20	0	0	5(5)	25(25)	0	0	0	0	0	0	0	0
Total	30	35(35)	490(15	100(25)	455(10)	100(100)		4495	5	245	5	210

* - Aerobic Mesophiles - Av of 2

** - Contaminated - lab accident

† - Clothing violations (QA Log)

( ) - Spore Count

VIII APPENDICES

APPENDIX A

PARTS LIST

SUB - ASSY. #100

PART NO.	QTY.	NOMENCLATURE
100	1	HOUSING ASSEMBLY
90	1	HOUSING
80	1	HOLDING RING
70	3	SCREW (HOLDING RING)
60-1	1	LOCK ARM
-2	1	LOCK ARM
-3	1	LOCK ARM
-4	1	LOCK ARM
-5	1	LOCK ARM
-6	1	LOCK ARM
-7	1	LOCK ARM
-8	1	LOCK ARM
-9	1	LOCK ARM
-10	1	LOCK ARM
50-1	1	FLAT WASHER
-2	1	FLAT WASHER
-3	1	FLAT WASHER
-4	1	FLAT WASHER
-5	1	FLAT WASHER
-6	1	FLAT WASHER
-7	1	FLAT WASHER
-8	1	FLAT WASHER
-9	1	FLAT WASHER
-10	1	FLAT WASHER

APPENDIX A

PARTS LIST

SUB-ASSY #100 CONT.

PART NO.	QTY.	NOMENCLATURE
40-1	1	SPRING (LOCK ARM)
-2	1	
-3	1	
-4	1	
-5	1	
-6	1	
-7	1	
-8	1	
-9	1	
-10	1	

APPENDIX A

PARTS LIST

SUB-ASSY #200

PART NO.	QTY.	NOMENCLATURE
200	1	DRIVE SHAFT
190	1	DRIVE SHAFT
180	1	LOCK RING (SPANNER TYPE)
170	1	LOCATING RING (DRIVE SHAFT)
160	1	DRIVE PIN
150		FLAT WASHER (DRIVE SHAFT TOP)
140	5	FLAT WASHER (DRIVE SHAFT LOWER)
130-1	1	STOP RING
2	1	STOP RING
3	1	STOP RING
4	1	STOP RING
5	1	STOP RING
6	1	STOP RING
7	1	STOP RING
8	1	STOP RING
9	1	STOP RING
10	1	STOP RING

APPENDIX A

PARTS LIST

SUB-ASSY #200 CONT.

PART NO.	QTY.	NOMWNCLATURE
120-1	1	FLAT WASHER (STOP RING)
2	1	FLAT WASHER (STOP RING)
3	1	FLAT WASHER (STOP RING)
4	1	FLAT WASHER (STOP RING)
5	1	FLAT WASHER (STOP RING)
6	1	FLAT WASHER (STOP RING)
7	1	FLAT WASHER (STOP RING)
8	1	FLAT WASHER (STOP RING)
9	1	FLAT WASHER (STOP RING)
110-1	1	SPRING, FLAT (STOP RING
2	1	SPRING, FLAT (STOP RING)
3	1	SPRING, FLAT (STOP RING)
4	1	SPRING, FLAT (STOP RING)
5	1	SPRING, FLAT (STOP RING)
6	1	SPRING, FLAT (STOP RING)
7	1	SRPING FLAT (STOP RING)
8	1	SPRING, FLAT (STOP RING)
9	1	SPRING, FLAT (STOP RING)
10	1	SPRING, FLAT (STOP RING)

APPENDIX A

PARTS LIST

ASSEMBLY #300

PART NO.	QTY.	NOMENCLATURE
300	1	TOP ASSEMBLY
100	1	HOUSING ASSY.
200	1	DRIVE SHAFT ASSY.
295	1	CALIBRATION GEAR HOUSING
290	1	LOCK DRIVE SHAFT
285	1	PIN, DRIVE SHAFT LOCK
280	2	SCREW, ALLEN
275	1	HOUSING, GEAR
265	1	GEAR, ROLLER BEARING
260	1	RING, HOLDING
255	1	PIN, KEEPER
250	1	SPRING PRESSURE
245	1	WASHER, BEARING
240	1	BEARING (LOWER DRIVE SHAFFT)
235	4	POST, STAND-OFF
230	3	SCREW (POST, STAND-OFF)
225	1	SCREW, POST (POST, STAND-OFF)
220	1	PLATE, LOWER (CASTING)
215	4	WASHER, FLAT KEY
210	4	STAND-OFF THREADED

APPENDIX B

ASSEMBLY OPERATION SEQUENCE

PART NO. 100 - HOUSING ASSEMBLY

OP. NO.

10. ASSEMBLE PART NO. 60-1 STOP ARM ON SMOOTH POST OF PART NO. 90 HOUSING, FOLLOW WITH PART NO. 50-1 FLAT WASHER. COMPLETE ASSEMBLY BY ALTERNATING PART NOS. 60-2 THRU 60-10 AND PART NOS. 50-2 THRU 50-10.

20. ASSEMBLE PART NOS. 40-1 SPRING THRU 40-10 ON SERRATED POST OF PART NO. 90 HOUSING. DO NOT INSERT SPRING UNDER 60-1 THRU 60-10 STOP ARM UNTIL COMPLETION OF OPERATION NO. 3.

30. ASSEMBLE PART NO. 80 HOLDING RING TO PART NO. 90 HOUSING USING (3) NO. 70 SCREW.

APPENDIX B

ASSEMBLY OPERATION SEQUENCE

PART NO. 200 DRIVE SHAFT ASSEMBLY

OP. NO.

10.	ASSEMBLE PART NO. 110-1 SPRING, FLAT ON PART NO. 190 DRIVE SHAFT, FOLLOW WITH PART NO. 120-1 FLAT WASHER AND PART NO. 130-1 STOP RING. CONTINUE WITH THIS SEQUENCE FOR PART NOS. 110-2 THRU 110-10, PART NO. 120-2 THRU 120-10, AND PART NOS. 130-2 THRU 130-10.
20.	ASSEMBLE PART NO. 180 LOCK RING (SPANNER TYPE), ON PART NO. 190 DRIVE SHAFT AND SCREW LOCK IN POSITION. ASSEMBLE (2) PART NO. 140 FLAT WASHER (DRIVE SHAFT LOWER).
30.	ASSEMBLE PART NO. 170 LOCATING RING TO PART NO. 190 DRIVE SHAFT THEN INSERT PART NO. 160 DRIVE PIN. ASSEMBLE (2) PART NO. 150 FLAT WASHERS (DRIVE SHAFT TOP).

APPENDIX B

ASSEMBLY OPERATION SEQUENCE

PART NO. 300 TOP ASSEMBLY

OP. NO.	
10.	ASSEMBLE PART NO. 200 DRIVE SHAFT ASSY. TO PART NO. 100 HOUSING ASSY. INSERT PART NO. 40-1 PART 40-10 SPRING (LOCK ARM) UNDER PART NO. 60-1 THRU 60-10 LOCK ARM IN PART NO. 100 HOUSING ASSY.
20.	ASSEMBLE PART NO. 295 CALIBRATION GEAR HOUSING TO PART NO. 200 DRIVE SHAFT ASSY. INSERT PART NO. 285 PIN DRIVE SHAFT LOCK INTO PART NO. 200 DRIVE SHAFT ASSY.
30.	ASSEMBLE PART NO. 290 LOCK, DRIVE SHAFT USING (2) PART NO. 280 SCREWS, ALLEN.
40.	ASSEMBLE PART NO. 275 HOUSING HEAR TO PART NO. 200 DRIVE SHAFT ASSY. AND PART NO. 100 HOUSING ASSY.
50.	ASSEMBLE PART NO. 265 GEAR, ROLLER BEARING TO PART NO. 200 DRIVE SHAFT ASSY. INSERT PART NO. 255 PIN, KEEPER INTO DRIVE SHAFT.
60.	ASSEMBLE PART NO. 260 RING, HOLDING, PART NO. 250 SPRING, PRESSURE, PART NO. 245 WASHER BEARING AND PART NO. 240 BEARING (LOWER DRIVE SHAFT).
70.	ASSEMBLE (4) PART NO. 235 POST, STAND-OFF TO PART NO. 100 HOUSING ASSY. USING (3) PART NO. 230 SCREW, (POST, STAND-OFF) AND (1) PART NO. 225 SCREW, POST (POST, STAND-OFF) WITH (4) PART NO. 215 WASHER, FLAT KEY.
80.	ASSEMBLE PART NO. 220 PLATE LOWER (CASTING) TO DRIVE SHAFT AND PART NO. 235 POST, STAND-OFF USING (4) PART NO. 210 STAND-OFF, THREADED.

APPENDIX B

EASL Environments during construction.

Timer Number	EASL Condition
1, 2 and 3	EASL on environmental specification
4, 5 and 6	EASL at 83°F and 20-25% R.H.
7, 8 and 9	EASL at 83°F and 45% R.H. or as close to 45% as possible.
10, 11 and 12	EASL on specification for temperature and relative humidity, but blowers shut down during construction of the timers.

Sequence of timer construction.

1. Timer will be assembled in the following chronological order:

Assembly

1st	Timer #1	7th	Timer #8
2nd	Timer #4	8th	Timer #9
3rd	Timer #5	9th	Timer #3
4th	Timer #6	10th	Timer #10
5th	Timer #2	11th	Timer #11
6th	Timer #7	12th	Timer #12

APPENDIX C

DISASSEMBLY OPERATION
SEQUENCE

PART NO. 300 TOP ASSEMBLY

OP. NO.

10. DISASSEMBLE (4) PART NO. 210 STAND-OFF, THREADED, (1) PART NO. 220 PLAT, LOWER (CASTING), (3) PART NO. 230 SCREW (POST, STAND-OFF), (1) PART NO. 225 SCREW, POST (POST, STAND-OFF) (4) PART NO. 215 WASHER, FLAT KEY AND (4) PART NO. 235 POST STAND-OFF.

ASSAY GROUP (1) THRU (3)

1. (4) #210 STAND-OFF THREADED, (3) SCREW
   (1) #225 SCREW, POST AND (4) #235 POST, STAND-OFF
2. (1) #220 PLATE, LOWER (CASTING).
3. (4) #215 WASHER, FLAT KEY.

APPENDIX C

OP. NO.

20. DISASSEMBLE (1) PART NO. 240 BEARING (LOWER DRIVE SHAFT), (1) PART NO. 245 WASHER, BEARING, (1) PART NO. 250 SPRING, PRESSURE, (1) PART NO. 260 RING, HOLDING, (1) PART NO. 255 PIN, KEEPER, (1) PART NO. 265 GEAR, ROLLER BEARING, (1) PART NO. 275 HOUSING GEAR.

ASSAY GROUP (4) THRU (7)

4. (1) #240 BEARING, (1) #245 WASHER, BEARING, (1) #255 PIN KEEPER AND (1) #260 RING HOLDING=

5. (1) #250 SPRING, PRESSURE.

6. (1) #256 GEAR, ROLLER BEARING

7. (1) #275 HOUSING, GEAR.

APPENDIX C

OP. NO.

30 DISASSEMBLE (2) PART NO. 280 SCREW, ALLEN, (1) PART NO. 290 LOCK, DRIVE SHAFT, (1) PART NO. 295 CALIBRATION GEAR HOUSING AND (1) PART NO. 285 PIN, DRIVE SHAFT LOCK

ASSAY GROUP (8)

8. (2) #280 SCREW, ALLEN, (1) ±290 LOCK, DRIVE SHAFT. (1) #285 PIN, DRIVE SHAFT LOCK AND (1) #295 CALIBRATION GEAR HOUSING.

40. DISASSEMBLE PART NO. 200 DRIVE SHAFT SUB-ASSY. FROM PART NO. 100 HOUSING ASSY. BY RELEASING THE SPRING TENSION ON THE (10) LOCK ARMS.

50. DISASSEMBLE THE NO. 200 DRIVE SHAFT ASSY. AS FOLLOWS: REMOVE (5) PART NO. 140 WASHER, FLAT (DRIVE SHAFT LOWER), (2) PART NO. 150 WASHER, FLAT (DRIVE SHAFT TOP). REMOVE PART NO. 160 DRIVE PIN FROM PART 170 LOCATING RING AND PART NO. 190 DRIVE SHAFT. SLIP LOCATING RING FROM DRIVE SHAFT. REMOVE PART NO. 180 LOCK RING. DISASSEMBLE THE (10) PART NO. 130-1 THRU-10 STOP RINGS, (10) PART NO. 110-1 THRU-10 SPRINGS AND (9) PART NO. 120-1 THRU-9 WASHERS FLAT=

ASSAY GROUP (9) THRU (14) SEE FIG. 1

9. (5) #140 WASHERS, FLAT (DRIVE SHAFT LOWER) AND (2) #150 WASHERS, FLAT (DRIVE SHAFT TOP).

10. (1) #160 DRIVE PIN, (1) #170 LOCATING RING AND (1) #180 LOCK RING.

11. (10) #130-1 THRU-10 STOP RING.

12. (10) #110-1 THRU-10 SPRINGS

13. (9) #120-1 THRU-9 WASHERS, FLAT

14. (1) #190 DRIVE SHAFT.

OP. NO.

60. DISASSEMBLE THE PART NO. 100 HOUSING SUB-ASSY AS FOLLOWS:

REMOVE (3) PART NO. 70 SECREWS FROM PART NO. 80 HOLDING RING AND PART NO. 90 HOUSING. USING SCREW DRIVER REMOVE PART NO. 80 HOLDING RING. FROM THE HOUSING POST SLIP OFF (10) PART NO. 50-1 THRU 50-10 WASHER, FLAT AND (10) PART NO. 60-1 THRU 60-10 LOCK ARMS. FROM THE OPPOSITE HOUSING POST REMOVE (10) PART NO, 40-1 THRU 40-10 SPRINGS.

ASSAY GROUP (15) THRU (20) SEE FIG. 1

15. (3) #70 SCREWS

16. (1) #80 HOLDING RING

17. (10) #61-1 THRU-10 LOCK ARMS

18. (10) #50-1 THRU-10 WASHERS FLAT.

19. (10) #40-1 THRU-10 SPRINGS

20. (1) #90 HOUSING.

APPENDIX D

BIO ASSAY GROUPS PARTS LIST

(#300 Timer Assembly)

1. (4) #210 STAND-OFF THREADED, (3) #230 SCREW
   (1) #225 SCREW, POST AND (4) #235 POST, STAND-OFF.
2. (1) #220 PLATE, LOWER (CASTING).
3. (4) #215 WASHER, FLAT KEY.
4. (1) #240 BEARING, (1) #245 WASHER, BEARING
   (1) #255 PIN, KEEPER AND (1) #260 RING, HOLDING.
5. (1) #250 SPRING, PRESSURE.
6. (1) #265 GEAR, ROLLER BEARING.
7. (1) #275 HOUSING, GEAR.
8. (2) #280 SCREW, ALLEN, (1) #290 LOCK, DRIVE SHAFT
   #285 PIN DRIVE SHAFT LOCK AND (1) #295 CALIBRATION GEAR HOUSING.
9. (5) #140 WASHERS, FLAT (DRIVE SHAFT LOWER) AND
   (2) #150 WASHER, FLAT (DRIVE SHAFT TOP).
10. (1) #160 DRIVE PIN, (1) #170 LOCATING RING AND
    (1) #180 LOCK RING.
11. (10) #130-1 THRU-10 STOP RING.
12. (10) #110-1 THRU -10 SPRINGS.
13. (9) #120-1 THRU-9 WASHERS, FLAT
14. (1) #190 DRIVE SHAFT.
15. (3) #70 SCREWS
16. (1) #80 HOLDING RING
17. (10) #61-1 THRU-10 LOCK ARMS
18. (10) #50-1 THRU-10 WASHERS, FLAT.
19. (10) #40-1 THRU-10 SPRINGS
20. (1) #90 HOUSING.

APPENDIX E

Statistical Analysis of data obtained using the Reynier Air Sampler

Clearly, the results (increased bio burden of air samples) were affected when the blowers were turned off. The data were analyzed to determine whether there is evidence of a significant trend caused by varied humidity and temperature conditions. The three conditions compared were the following:

A. EASL Specification temperature and relative humidity ($70 \pm 10^{\circ}F$ and $45\% \pm 5\%$ RH)

B. $83^{\circ}F$, 20 - 25% R.H.

C. $83^{\circ}F$, 45% R.H.

The data were further analyzed to determine whether there is evidence of significantly different results between geometric locations or replicate measurements, and whether the locale can be correlated with time. Student's "t" test was used to determine whether distributions significantly differed from one another. A 5% significance level was used.

The conclusions were as follows:

1. The difference between Reynier conditions A and B, between A and C and Between B and C are not significant (at a 5% significance level); i.e., the data do not offer significant evidence that burden is a function of humidity conditions.

2. The differences between readings obtained from any two of the three Reynier locations at which measurements were taken are not significant (at a 5% significance level); i.e., the data do not offer significant evidence that burden is a function of geometric location.

3. The differences between the Reynier air sampling readings obtained on May 1 and May 19 were not significant (at a 5% significance level); i.e., there is no significant evidence that the results are not repeatable.

REFERENCES

1. Jet Propulsion Laboratory Specification XOY - 50543 - Gen. (Revision) August 15, 1967.

2. Standard Procedures for the Microbiological Examination of Space Hardware, NASA Headquarters, Washington, DC, June 1, 1966.

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